

MILITARY SPECIFICATION
DELAY LINES, PASSIVE,
GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for fixed passive (tapped and untapped) pulse delay lines.

1.2 Classification.

1.2.1 Military part number. The military part number shall consist of the letter "M", the specification sheet number (single-digit slash numbers shall be preceded by zero), and an assigned dash number.

EXAMPLE:

M	83531/01	-001
Military designator	Specification sheet number	Dash number

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

J-W-1177	-	Wire, Magnet, Electrical.
QQ-S-571	-	Solder, Tin Alloy; Tin-Lead Alloy; and Lead Alloy.

MILITARY

MIL-C-123	-	Capacitor, Fixed, Ceramic Dielectric (Temperature Stable and General Purpose), High Reliability, General Specification For.
MIL-F-14256	-	Flux, Soldering, Liquid (Rosin Base).
MIL-S-19491	-	Semiconductor Device, Packaging of.
MIL-R-55342	-	Resistor, Fixed, Film, Chip, Established Reliability, General Specification For.
MIL-C-55681	-	Capacitor, Chip, Multiple Layer, Fixed, Unencapsulated, Ceramic Dielectric, Established Reliability, General Specification For.
MIL-C-83446	-	Coil, Radio Frequency, Chip, Fixed or Variable, General Specification For.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Electronic Support Division AFLC, 2750 ABW/ES, Gentile Air Force Station, Dayton, OH 45444 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

STANDARDS

FEDERAL

FED-STD-H28 - Screw Thread Standards for Federal Services.

MILITARY

DOD-STD-100 - Engineering Drawing Practices.
 MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
 MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
 MIL-STD-454 - Standard General Requirements for Electronic Equipment.
 MIL-STD-790 - Reliability Assurance Program for Electronic Parts Specifications.
 MIL-STD-810 - Environmental Test Methods and Engineering Guidelines.
 MIL-STD-1276 - Leads for Electronic Component Parts.
 MIL-STD-1285 - Marking of Electrical and Electronic Parts.
 MIL-STD-45662 - Calibration Systems Requirements.

(Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publication. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

ELECTRONIC INDUSTRIES ASSOCIATION (EIA) STANDARD

RS-242 - Definitions for Electro-Magnetic Delay Lines.

(Application for copies should be addressed to the Electronic Industries Association Engineering Office, 11 West 42nd Street, New York, NY 10036.)

(Non-Government standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between the requirements of this specification and the individual specification sheets, the latter shall govern (see 6.2).

3.2 Qualification. Delay lines furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.4 and 6.3). In addition, the manufacturer shall certify in writing that the product assurance requirements of 3.3 have been met and are being maintained.

3.3 Product assurance requirements. Delay lines shall have been subjected to and passed all applicable requirements, tests, and inspections detailed herein, including qualification and quality conformance inspection requirements and the reliability assurance program.

3.3.1 Reliability assurance. A reliability assurance program for delay lines furnished under this specification shall be established and maintained in accordance with the procedures and requirements specified in MIL-STD-790, with the following exceptions:

- a. Corrective action only for failures exceeding the allowable number.
- b. The manufacturer is not required to document training.
- c. The manufacturer shall identify the critical operations and critical control points in the production process. Suitable control records shall be maintained and corrective actions taken when these indicate that the process is not in control.
- d. Manufacturer's internal audit is not required.
- e. Audits of subassembly manufacturers are not required.

3.4 Materials. The materials shall be as specified herein; however, when a definite material is not specified, a material shall be used which will enable the delay lines to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product (see 4.6.1).

3.4.1 Flammable materials. Materials used in the construction of delay lines shall be nonflammable and nonexplosive.

3.4.2 Corrosive materials. Corrosive materials used in any of the manufacturing processes shall be removed or neutralized so that no corrosion will result from such use. Materials used in the construction of delay lines shall be noncorrosive.

3.4.3 Solder and soldering flux. Solder shall be in accordance with QQ-S-571. Soldering flux shall be in accordance with MIL-F-14256.

3.4.4 Screws, nuts, and washers. All mounting and terminal screws, nuts, and washers shall be of corrosion-resistant material or shall be protected against corrosion.

3.4.5 Case material. Unless otherwise specified (see 3.1), cases may be of metallic or nonmetallic material. All metallic surfaces shall be protected against corrosion by a suitable finish and shall be free from blisters and other defects which may affect the protective properties of this finish.

3.4.6 Terminals. Terminals shall be solder lug terminals, printed-circuit and dual-in-line terminals, or solid-wire lead terminals, as specified (see 3.1). All solder type terminals shall be capable of complying with the solderability requirements of this specification.

3.4.7 Passive circuit elements for all delay lines. Capacitor, inductor, or resistor circuit elements shall be qualified MIL-C-123, MIL-C-55681, MIL-C-83446 or MIL-R-55342 devices, or shall be screened to the applicable specification.

3.4.8 Magnet wire. Magnet wire shall be in accordance with J-W-1177.

3.4.9 Electronic components. Electronic components shall be selected in accordance with the applicable requirements of MIL-STD-454. Delay lines shall meet the performance requirements and product characteristics specified herein. After qualification, any changes in parts or materials shall be submitted to the Government qualifying activity for approval.

3.5 Design and construction. Delay lines shall be of the design, construction, and physical dimensions specified in the applicable specification sheet (see 3.1).

3.5.1 Dimensions. When delay lines are inspected in accordance with 4.6.2, the dimensions shall be within the tolerances specified on the specification sheet (see 3.1).

3.5.2 Visual inspection. When delay lines are inspected in accordance with 4.6.3, they shall not exhibit flaking, pitting, blistering, peeling, cracks, bursting, bulging, or other defects. The delay lines shall also meet the requirements of 3.1, 3.22, and 3.23.

3.6 Thermal shock. When delay lines are tested as specified in 4.6.4, not more than 10 percent of the surface shall have peeling, flaking, chipping, cracking, or other impairment of the protective finish; no evidence of other physical damage such as cracks, bursting, or bulging of the case; or other defects that would affect the mechanical or electrical operation, and there shall be no electrical discontinuity.

3.7 Seal. When delay lines are tested as specified in 4.6.5 there shall be no evidence of continuous air bubble flow or compound leakage.

3.8 Electrical characteristics. Delay lines shall be capable of meeting all the electrical requirements (3.8.1 through 3.8.7) specified (see 3.1).

3.8.1 Delay time. When tested in accordance with 4.6.6.1.1, the overall specified delay time of the line shall be as specified. The input-to-tap and tap-to-sequential tap shall be as specified (see 3.1).

3.8.2 Rise time. When measured in accordance with 4.6.6.1.2, the rise time of pulses taken at the point of maximum delay shall not exceed the value specified (see 3.1). The rise time measured at the taps shall not exceed the rise time required at the point of maximum delay.

3.8.3 Voltage attenuation. When measured in accordance with 4.6.6.1.3, the voltage attenuation of pulses taken at the point of maximum delay with respect to the input pulse amplitude shall not exceed the value specified (see 3.1). The voltage attenuation measured at the taps shall not exceed the voltage attenuation required at the point of maximum delay.

3.8.4 Distortion. Unless otherwise specified (see 3.1), when measured in accordance with 4.6.6.1.4, the all encompassing distortion of pulses appearing at the point of maximum delay shall not exceed ± 10 percent.

3.8.5 Delay time variation with temperature. When tested in accordance with 4.6.6.1.5, the delay time variation with temperature shall not exceed the value specified (see 3.1).

3.8.6 DC resistance. When delay lines are tested as specified in 4.6.6.1.6, the dc resistance shall be as specified (see 3.1).

3.8.7 Nominal characteristic impedance. When tested in accordance with 4.6.6.1.7, nominal characteristic impedance shall be as specified on individual specification sheets (see 3.1).

3.8.8 Insulation resistance. Unless otherwise specified (see 3.1), when delay lines are tested in accordance with 4.6.6.1.8, the minimum insulation resistance shall be 1,000 megohms (M Ω).

3.9 Resistance to solvents. When delay lines are tested as specified in 4.6.7, there shall be no evidence of mechanical damage and the markings shall remain legible. The paint or exterior finish shall not soften, peel, or show other signs of deterioration.

3.10 Solderability. When delay lines are tested as specified in 4.6.8, they shall meet the applicable criteria for terminal evaluation in the test method.

3.11 Moisture resistance. When tested in accordance with 4.6.9, there shall be no evidence of other physical damage that would affect the mechanical or electrical operation of the line, and there shall be no evidence of electrical discontinuity.

3.12 Salt spray (corrosion) (when specified, see 3.1). When delay lines are tested as specified in 4.6.10, there shall be no evidence of corrosion as exhibited by any visible degradation of the surfaces that can be attributed to flaking, pitting, blistering, or otherwise loosened protective coating or metal surface.

3.13 Vibration. When delay lines are tested as specified in 4.6.11, there shall be no leakage of filling material and no evidence of other physical damage such as cracks, bursting, or bulging of the case. There shall be no evidence of mechanical damage and there shall be no electrical discontinuity during the test.

3.14 Shock. When delay lines are tested as specified in 4.6.12, there shall be no leakage of filling material and no evidence of other physical damage such as cracks, bursting, or bulging of the case. There shall be no evidence of mechanical damage and there shall be no electrical discontinuity during the test.

3.15 Life. When delay lines are tested as specified in 4.6.13, there shall be no evidence of impairment to the protective finish or of other physical damage such as cracks, bursting, or bulging of the case, and there shall be no evidence of electrical discontinuity.

3.16 Terminal strength. When delay lines are tested as specified in 4.6.14 inclusive, there shall be no evidence of loosening, rupturing, or other mechanical damage. Bends shall not be considered as damage unless surface cracking is evident. Except for flexible leads, there shall be no rotation of the terminals. Rotation of the external portion of the metallic portion of a "hook" type terminal exceeding 10 degrees shall constitute a failure.

3.17 Fungus. The manufacturer shall certify that all external materials are nonnutrient to fungus growth or are suitably treated to retard fungus growth, or shall perform the test specified in 4.6.15. When delay lines are tested as specified in 4.6.15, there shall be no evidence of fungus growth on the external surface.

3.18 Dielectric withstanding voltage at reduced barometric pressure. When delay lines are tested as specified in 4.6.16, there shall be no arcing, flashover, breakdown of insulation, or other evidence of damage.

3.19 Resistance to soldering heat. When delay lines are tested as specified in 4.6.17, there shall be no softening of the insulation or loosening of the windings or terminals, no evidence of internal solder reflow or heat damage, and there shall be no evidence of discontinuity.

3.20 Flammability. When delay lines are tested as specified in 4.6.18, there shall be no evidence of violent burning which results in an explosive-type fire, and the coating material used shall be self-extinguishing. Delay lines shall not be considered to have failed in the event that they are consumed by the applied flame. Delay lines shall be considered to have failed only if an explosion or dripping of flaming material occurs, an explosive-type flame is produced, or if visible burning continues beyond the allowable duration of three minutes after removal of the applied flame.

3.21 Winding continuity. When delay lines are tested as specified in 4.6.19, all windings shall be electrically continuous.

3.22 Marking.

3.22.1 JAN and J marking. The United States Government has adopted, and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of military specifications. Accordingly, items acquired to, and meeting all the criteria specified herein and in applicable detail specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in applicable detail specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets or detail specifications, the manufacturer shall remove the "JAN" or the "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration No. 504,860 for the certification mark "JAN".

3.22.2 Full marking. Each delay line shall be marked on the top in accordance with method I of MIL-STD-1285 with the following information:

- a. "JAN" or "J" marking.
- b. Military part number.
- c. Index mark identification (next to pin 1, input).
- d. Manufacturer's source code or logo.
- e. Date code.

3.23 Workmanship. Delay lines shall be processed in such a manner as to be uniform in quality and shall be free from defects that will affect life and serviceability. Parts shall be free of flash pits, voids, and excessive mold marks. A visible parting line is acceptable.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the manufacturer. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-STD-45662.

4.1.3 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with 3.3.1.

4.2 Classification of inspections. The inspections specified herein are classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202.

4.3.1 Reference test circuit, test equipment, and measurements. Reference test circuit, test equipment, and measurements shall be as specified in 4.3.1.1 through 4.3.1.6. Any equivalent test circuit may be used. In case of conflict, the reference test circuit shall take precedence.

4.3.1.1 Reference test circuit. The reference test circuit shall be as shown on figure 1. The pulse generator shall be loaded with an L pad to match delay line impedance to generator. The delay line shall be terminated in the nominal terminating impedance within ± 1 percent. The test circuit capacitances, including probe, shall not exceed 3 picofarads (pF). Waveform characteristics are shown on figure 2.

4.3.1.2 Test equipment. The test equipment shall be as follows:

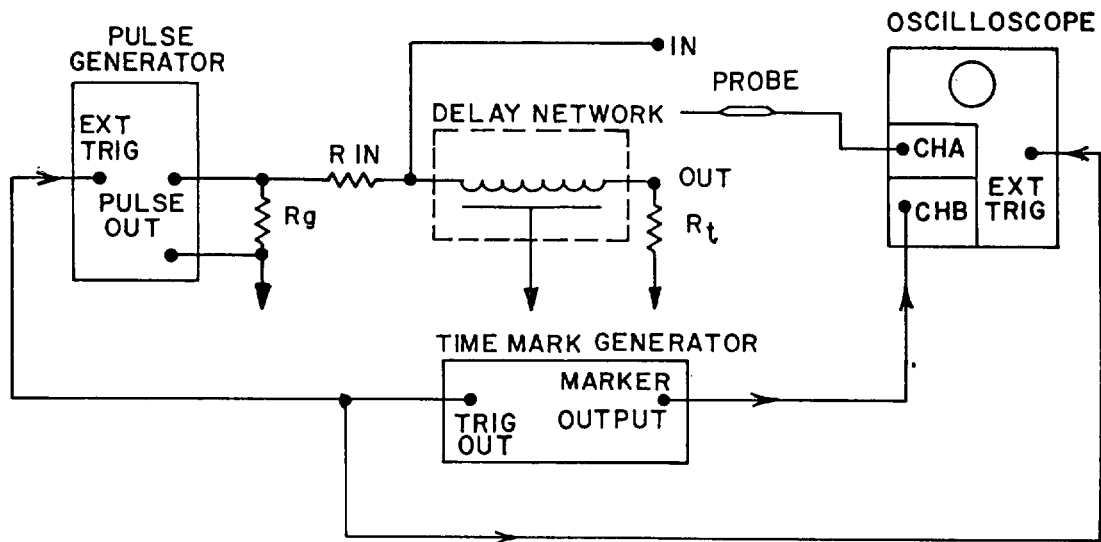
- a. Marker generator: Tektronix type TG501 or type 2901, or equivalent.
- b. Pulse generator: Capable of 1 nanosecond (ns) rise time when measuring time, and 5 ns when measuring distortion.
- c. Oscilloscope: 350 megahertz (MHz) bandwidth minimum, analog, dual channel.
- d. Probe: The oscilloscope's recommended probe should be used. The probe capacitance and circuit capacitance shall be 3 pF maximum at probe tip. The probe impedance shall be 10 times the impedance of the device being measured, minimum.
- e. Test fixture: A fixture with a massive ground plane shall be used. All lead lengths 0.25 inch maximum. Stray capacitance and inductance shall be kept below 3 pF and 10 nanohenrys (nh) respectively. Resistors shall be noninductive types. Coaxial cables shall be used. RG-58 c/u or equivalent, 18 inches length maximum.

4.3.1.3 Delay measurements. The basic steps for measurement of delay shall be as follows:

- a. Establish reference $t_d = 0$.
- b. Sweep speed: Use sweep speed such that the output rise is displayed across 4 centimeters (cm) (minimum) so that it crosses the screen at approximately 45 degrees. The markers may then be chosen so as to provide a mark each 1 to 2 cm.
- c. Display markers selected (b. above) on channel B.
- d. Display input pulse on channel A. Set amplitude deflection for 100 percent (4 cm minimum).
- e. Adjust "pulse position vernier" on pulse generator for coincidence of 50 percent amplitude (.5E_i) point of input pulse and a reference marker.
- f. To measure delay of output pulse, move channel A probe to output test point.
- g. Adjust delay time on oscilloscope, counting markers, until the output pulse is displayed.
- h. Adjust amplitude deflection on channel A to 100 percent (4 cm minimum).
- i. Delay equals the number of markers plus increment between last marker and 50-percent point (.5E_o) of output pulse.

4.3.1.4 Rise time measurements. Rise time measurements shall be made as follows:

- a. Set sweep speed such that the output rise is displayed across 4 cm minimum so that it crosses the screen at approximately 45 degrees. The markers may then be chosen so as to provide a mark approximately 1/10 the rise time being measured or 1 ns, whichever is greater.
- b. Display markers selected (a. above) on channel B.
- c. Display input pulse (input test point) on channel A. Set amplitude deflection for 100 percent (4 cm minimum).



NOTES:

1. All measurements refer to definitions of EIA standard RS-242.
 R_{IN} = Input matching resistance.
 R_g = Generator terminating impedance.
 R_t = Terminating resistance.

FIGURE 1. Reference test circuit.

Nominal terminating impedance $\pm 1\%$	R_{in} $\pm 5\%$	R_a $\pm 5\%$
* 50 Ω	25.0	50.0
100 Ω	70.7	70.7
200 Ω	173.2	57.7
250 Ω		
300 Ω		
350 Ω	324.0	54.0
360 Ω	334.1	53.9
400 Ω		
500 Ω	474.3	52.7

* No pad used when terminating impedance is 50 Ω .

FIGURE 1. Reference test circuit - Continued.

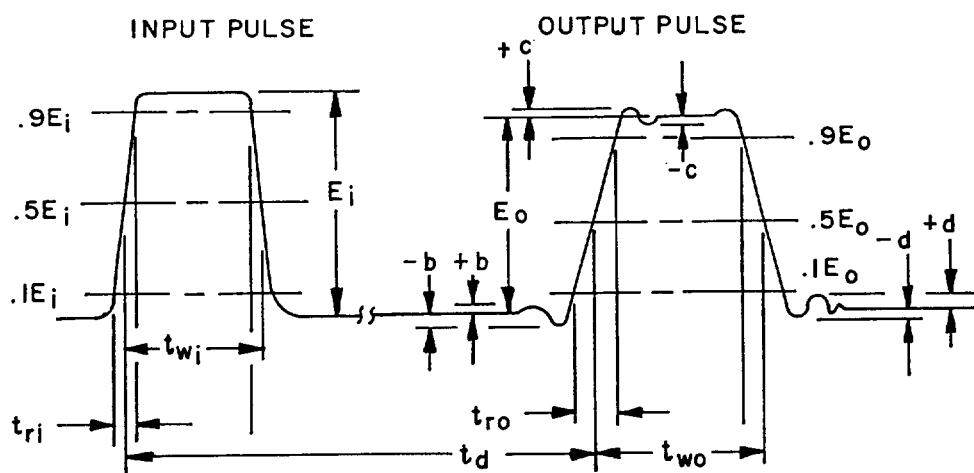


FIGURE 2. Waveform characteristics.

- d. Adjust input pulse rise time (t_{ri}) after replacing the delay line with a direct short between the input and output terminals. The shorting wire should be as short as possible. Measure at test fixture input.
- e. Remove short and reinstall delay line. Measure output rise time by moving channel A probe to output test point.
- f. Adjust delay time on oscilloscope until the output pulse is displayed.
- g. Adjust amplitude deflection on channel A to 100 percent (4 cm minimum).
- h. Measure output pulse rise time (t_{ro}) (from point $.1E_0$ to $.9E_0$).
- i. If another method of measuring rise time is used, the following formula may apply:

$$\text{True rise time} = \sqrt{t_{ro}^2 - t_{ri}^2}$$

4.3.1.5 Distortion measurements. Distortion measurements shall be made as follows:

- a. Display entire output pulse width using 4 cm minimum of oscilloscope screen. Adjust amplitude deflection on channel A for 100 percent (4 cm minimum) deflection.
- b. Measure amplitudes of output pulse distortion b, c, and d (see RS-242).
- c. Calculate delay line output pulse distortion (S_0) using worst case conditions (see RS-242).

$$(S_0)\% = \frac{+1b1 + 1c1 + 1d1}{E} \times 100$$

NOTE: 1b1, 1c1, and 1d1 represent the largest peak amplitudes.

4.3.1.6 Voltage attenuation measurements. Voltage attenuation measurements shall be made as follows:

- a. Connect a short between the "in" and "out" points shown on figure 1.
- b. Adjust scope to display input pulse amplitude as for delay time. Measure input pulse amplitude (E_i) at input test point.
- c. Remove short and replace with the delay line under test.
- d. Move probe to output test point.
- e. Adjust delay time on oscilloscope to display output pulse.
- f. Measure output pulse amplitude (E_o).
- g. Calculate attenuation (see RS-242).

$$\text{Voltage attenuation} = \frac{E_i - E_o}{E_i} \times 100$$

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.4.1 Sample. The number of units comprising a sample of delay lines to be submitted for qualification inspection shall be as specified in table I.

4.4.2 Test routine. Qualification samples shall be subjected to the tests of table I, in the order shown. All sample units shall be subjected to the tests of group I. The sample delay lines shall then be divided into three groups (see table I). The tests within each group shall be performed in the order shown.

4.4.3 Failures. Failures in excess of those allowed in table I shall be cause for refusal to grant qualification.

4.4.4 Extent of qualification. Extent of qualification shall be applicable only for delay lines on the same specification sheet. As a requisite for extension of qualification the product involved must be manufactured using the same facilities, processes, and materials as the product originally submitted for qualification. Qualification of the lowest total delay time and highest total delay time for a given specification sheet will extend qualification for all intermediate total delay values. Lowest delay time shall have lowest impedance; highest delay time shall have highest impedance.

4.4.5 Retention of qualification. To retain qualification, the contractor shall forward a report at least every 12 months to the qualifying activity. The qualifying activity shall establish the reporting date. The report shall consist of:

- a. A summary of the results of the tests performed for group A inspection indicating, as a minimum, the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.
- b. A summary of the results of tests performed for group B inspection including the number and mode of failures. The summary shall include results of all group A inspection tests performed and completed during the reporting period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list. Failure to submit the report within 30 days after the end of each reporting period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity if, at any time during the reporting period, the inspection data indicates failure of the qualified product to meet the requirements of this specification. In the event that no production occurred during the 12-month reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit the products (a representative sample of each delay line) to testing in accordance with the qualification inspection requirements. In addition to the above, the manufacturer shall requalify every 36 months. Actual group A and group B test data shall be submitted to the qualifying activity upon request.

4.5 Quality conformance inspection and in-process inspection.

4.5.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A inspection.

4.5.1.1 Inspection lot. An inspection shall consist of all delay lines of a single part number, produced under essentially the same conditions, and offered for inspection at one time.

4.5.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table II, in the order shown.

4.5.1.2.1 Sampling plan. Statistical sampling and inspection shall be in accordance with MIL-STD-105 for general inspection level II. The acceptable quality level (AQL) shall be as specified in table II. Major and minor defects shall be as defined in MIL-STD-105. One-hundred percent inspection shall be performed as specified in table II.

TABLE I. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph	Number of sample units	Number of failures
<u>Group I</u>				
Dimensions	3.5.1	4.6.2	22	2
Thermal shock (50 cycles)	3.6	4.6.4		
Seal	3.7	4.6.5		
Electrical characteristics	3.8	4.6.6		
Visual inspection <u>1/</u>	3.5.2	4.6.3		
<u>Group II</u>				
Resistance to solvents	3.9	4.6.7	10	0
Solderability	3.10	4.6.8		
Moisture resistance	3.11	4.6.9		
Salt spray (metal cases)	3.12	4.6.10		
Vibration	3.13	4.6.11		
Shock	3.14	4.6.12		
Electrical characteristics	3.8	4.6.6		
Visual inspection <u>1/</u>	3.5.2	4.6.3		
<u>Group III</u>				
Life	3.15	4.6.13	6	0
Terminal strength	3.16	4.6.14		
Fungus <u>2/</u>	3.17	4.6.15		
Electrical characteristics	3.8	4.6.6		
Dielectric withstanding voltage	3.18	4.6.16		
Visual inspection <u>1/</u>	3.5.2	4.6.3		
<u>Group IV</u>				
Resistance to soldering heat	3.19	4.6.17	4	0
Flammability	3.20	4.6.18		

1/ The "JAN" or "J" marking and military part number are not required on qualification samples.

2/ Test shall not be performed if the manufacturer provides certification that all external materials are nonnutrient to fungus growth or suitably treated to retard fungus growth.

TABLE II. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	AQL (percent defective)	
			Major	Minor
Subgroup I				
Thermal shock (15 cycles)	3.6	4.6.4	100%	100%
Seal	3.7	4.6.5	"	"
Delay time (all taps and output)	3.8.1	4.6.6.1.1	"	"
Rise time (output only)	3.8.2	4.6.6.1.2	"	"
Voltage attenuation (output only)	3.8.3	4.6.6.1.3	"	"
Distortion (output only)	3.8.4	4.6.6.1.4	"	"
Delay time variation with temperature (output only)	3.8.5	4.6.6.1.5	"	"
Nominal characteristic impedance (at input)	3.8.7	4.6.6.1.7	"	"
Insulation resistance	3.8.8	4.6.6.1.8	"	"
Subgroup II				
Dimensions	3.5.1	4.6.2	1.0	4.0
Visual inspection	3.5.2	4.6.3	1.0	4.0
DC resistance	3.8.6	4.6.6.1.6	1.0	4.0

4.5.1.2.2 Rejected lots. Rejected lots are as follows:

- a. Subgroup I: Lots having more than 5 percent total rejects shall not be furnished on the contracts. Delay lines out of specification limits shall not be shipped with the lot.
- b. Subgroup II: If an inspection lot is rejected, the contractor may screen out defective units and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

4.5.1.2.3 Disposition of sample units. Sample units which have passed all the group A inspections shall be delivered on the contract or purchase order if the lot is accepted.

4.5.2 Periodic check test. Periodic check test shall consist of group B inspection. Except where the results of these tests have shown noncompliance with the applicable requirements (see 4.5.2.1.4), delivery of products which have passed group A shall not be delayed pending the results of group B inspection.

4.5.2.1 Group B inspection. Group B inspection shall consist of the inspections specified in table III, in the order shown. Group B inspection shall be made on sample units selected from inspection lots which have passed the group A inspection.

TABLE III. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Life	3.15	4.6.13
Resistance to solvents	3.9	4.6.7
Solderability	3.10	4.6.8
Salt spray (when applicable)	3.12	4.6.10
Shock	3.14	4.6.12
Terminal strength	3.16	4.6.14
Electrical characteristics	3.8	4.6.6
Dielectric withstanding voltage	3.18	4.6.16

4.5.2.1.1 Sampling plan. Every 12 months, 4 sample units of any total delay value of each specification sheet produced during the month prior to the annual inspection, shall be subjected to the inspection. If, during a 12-month period, qualification testing has been successfully completed on delay lines covered by extent of qualification (see 4.4.4), inspection may be omitted for that 12-month period.

4.5.2.1.2 Failures. If one or more sample units fail to pass group B inspection, the sample shall be considered to have failed.

4.5.2.1.3 Disposition of sample units. Sample units which have been subjected to group B inspection shall not be delivered on the contract or purchase order.

4.5.2.1.4 Noncompliance. If a sample fails to pass group B inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions, with essentially the same materials, processes, etc., and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the group B inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements for semiconductor devices in MIL-S-19491.

4.6 Methods of inspection.

4.6.1 Materials. The manufacturers shall certify in writing that the materials used meet all the requirements of 3.4.

4.6.2 Dimensions. All dimensions shall be measured with a suitable instrument (see 4.1.2) to the requirements of 3.5.1.

4.6.3 Visual inspection. Delay lines shall be visually inspected with normal or corrected 20/20 vision to meet the requirements of 3.5.2.

4.6.4 Thermal shock (see 3.6). Unless otherwise specified (see 3.1), delay lines shall be tested in accordance with method 107 of MIL-STD-202, measurements before and after: Winding continuity.

- a. Test condition B for group A. (Exception: Low temperature shall be -55°C and 15 cycles shall be used.)
- b. Test condition B-2 (50 cycles) for qualification and group B, except low temperature shall be -55°C.

4.6.5 Seal (see 3.7). Delay lines shall be tested in accordance with MIL-STD-202, method 112, test condition D.

4.6.6 Electrical characteristics (see 3.8).

4.6.6.1 Pulse methods. The delay time, rise time, attenuation, distortion, and thermal stability test shall be conducted by applying an input pulse with a rise time of 1 ns to 5 ns to the delay line. The terminating impedance of the delay line shall be resistive and within ±1 percent of the value specified. Unless otherwise specified (see 3.1), the source impedance shall be within ±5 percent of the value of the terminating impedance (see 4.3.1).

4.6.6.1.1 Delay time. The time delay of pulses taken at each tap and the output of delay lines shall be measured to determine conformance with 3.8.1. In the case of sectionalized lines, the time delay of any combination of tandem sections shall be measured.

4.6.6.1.2 Rise time. The rise time of pulses taken at the output terminals (for sectionalized lines with all sections in tandem), shall be measured to determine conformance with 3.8.2.

4.6.6.1.3 Voltage attenuation. The amplitude of pulses taken at the input and output terminals (for sectionalized lines with all sections in tandem), shall be measured and the attenuation computed (see 3.8.3).

4.6.6.1.4 Distortion. The distortion of pulses taken at the output terminals (for sectionalized lines with all sections in tandem), when the delay line is fed with the specified input pulses shall be measured to determine conformance with 3.8.4.

4.6.6.1.5 Delay time variation with temperature. The delay line shall be enclosed in a suitable thermal chamber in which the temperature shall be variable over the applicable temperature range (see 3.8.5). The delay line shall be allowed to reach thermal stability at a sufficient number of temperatures covering the applicable temperature range (see 3.8.5) and at each stabilized temperature the delay time shall be measured and the delay time variation from the reference temperature delay time shall be recorded (see 3.8.5).

$$\text{ppm/}^{\circ}\text{C} = \frac{(\text{total delay @ } 25^{\circ}\text{C}) - (\text{total delay @ } 125^{\circ}\text{C})}{(\text{total delay @ } 25^{\circ}\text{C}) (125^{\circ}\text{C} - 25^{\circ}\text{C})} 10^6$$

$$\text{ppm/}^{\circ}\text{C} = \frac{(\text{total delay @ } 25^{\circ}\text{C}) - (\text{total delay @ } -55^{\circ}\text{C})}{(\text{total delay @ } 25^{\circ}\text{C}) [25^{\circ}\text{C} - (-55^{\circ}\text{C})]} 10^6$$

4.6.6.1.6 DC resistance (see 3.8.6). Direct current (dc) resistance shall be measured in accordance with method 303 of MIL-STD-202.

4.6.6.1.7 Nominal characteristic impedance (at input) (see 3.8.7). Nominal characteristic impedance shall be measured with suitable equipment and shall conform to the values listed in applicable specification sheets (see 3.1).

4.6.6.1.8 Insulation resistance (see 3.8.8). The delay lines shall be subjected to the insulation resistance test outlined in method 302 of MIL-STD-202. The following details shall apply:

- a. Test condition: A.
- b. Measurements shall be taken between input and ground. For metal cases, also test between terminals and case.

4.6.7 Resistance to solvents (see 3.9). Delay lines shall be tested in accordance with method 215 of MIL-STD-202.

4.6.8 Solderability (see 3.10). Delay lines shall be tested in accordance with method 208 of MIL-STD-202. The following details shall apply:

- a. Special preparation of specimen: Sample units shall not have been soldered during any of the previous tests.
- b. Number of terminals of each part to be tested: All.

4.6.9 Moisture resistance (see 3.11). Unless otherwise specified (see 3.1), delay lines shall be tested in accordance with method 106 of MIL-STD-202. Load voltages not applicable, measurements before and after: Winding continuity.

4.6.10 Salt spray (corrosion) (see 3.12). Delay lines shall be tested in accordance with method 101 of MIL-STD-202, test condition A.

4.6.11 Vibration (see 3.13). Delay lines shall be tested in accordance with method 214 of MIL-STD-202. The following details shall apply:

- a. Method of mounting: Delay lines shall be mounted by soldering to a printed-wiring board.
- b. One test point.
- c. Test conditions I, K, 15 minutes.
- d. Measurements before and after: Winding continuity.

4.6.12 Shock (see 3.14). Unless otherwise specified (see 3.1), delay lines shall be tested in accordance with method 213 of MIL-STD-202, test condition I.

4.6.13 Life (see 3.15). Delay lines shall be tested in accordance with method 108 of MIL-STD-202. The following details shall apply:

- a. Distance of temperature measurements from specimens: Three inches in still air.
- b. Test temperature and tolerance: 125°C ±3°C (257°F ±5°F).
- c. Operating conditions: Three volts, square wave, 50% duty cycle, output loaded with terminating impedance, taps not loaded, pulse width shall be three times the nominal total delay.
- d. Test condition: D.
- e. Measurements: Electrical characteristics.

4.6.14 Terminal strength (see 3.16). Delay lines shall be tested in accordance with method 211 of MIL-STD-202, test condition A, applied force 5 pounds. One terminal on each test sample shall be subjected to the test.

4.6.15 Fungus (see 3.17). Unless certification is provided, delay lines shall be tested in accordance with method 508 of MIL-STD-810.

4.6.16 Dielectric withstanding voltage at reduced barometric pressure (see 3.18). Delay lines designed for operation above 10,000 feet shall be tested in accordance with method 105 of MIL-STD-202. The following details shall apply:

- a. Duration of application of test voltage: Not less than 1 second, or more than 5 seconds. The duration of the test shall begin when 95 percent of the test potential is reached.
- b. Points of application of test voltage: Between mutually insulated terminals. For metal cases, also test between terminals and case.
- c. Limiting value of surge current: Shall not exceed 5 milliamperes (mA).
- d. Test condition: C.
- e. Magnitude of test voltage: 50 volts dc.
- f. Examination during and after test: Delay lines shall be examined for evidence of arcing, flashover, breakdown of insulation, and damage.

4.6.17 Resistance to soldering heat (see 3.19). Delay lines shall be tested in accordance with method 210 of MIL-STD-202. The following details shall apply:

- a. Special preparation of specimen: None.
- b. Mount board shall not be metal clad.
- c. Test condition: D.
- d. Cooling time: Five minutes.
- e. Examinations after test: Electrical characteristics and x-ray in two perpendicular planes (the two largest surface areas).

4.6.18 Flammability (see 3.20). Delay lines shall be tested in accordance with method 111 of MIL-STD-202. The following details and exception shall apply:

- a. Point of flame application. The flame shall be applied to the body of each delay line.
- b. Allowable time for burning of visible flame on specimen: Three minutes maximum.
- c. Inspection during and after test: Delay lines shall be inspected for evidence of violent burning which results in an explosive-type fire, dripping or flaming material, and visible burning which continues beyond the allowable duration after removal of the applied flame.

4.6.19 Winding continuity (see 3.21). All windings of delay lines shall be tested for electrical continuity by any suitable means.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with the provisions specified for semiconductor devices in MIL-S-19491.

6. NOTES

6.1 Intended use. Delay lines covered by this specification are used in electronic equipment where a pulse delay is required.

6.2 Ordering data. For delay lines covered by specification sheets, acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Title, number, and date of the applicable specification sheet and the complete military part number.

6.2.1 For delay lines not covered by specification sheets. See figure 3.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable qualified products list whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the qualified products list is the 2750 ABW/ES, Gentile AF Station, Dayton, OH 45444-5000; however, information pertaining to qualification of products may be obtained from the Defense Electronics Supply Center, (DESC-E), Dayton, OH 45444-5000.

6.3.1 Copies of "Provisions Governing Qualification". Copies of SD-6, "Provisions Governing Qualification", may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

6.4 Subject term (key word listing).

Delay lines, Passive.

6.5 New specification sheets. A new specification sheet may be written by supplying the following:

- a. A proposed specification sheet (see an existing specification sheet).
- b. The difference(s) between the proposal and the most similar existing specification sheet.
- c. A list of military contracts or systems in which the proposed specification sheet part(s) have been used.

This information shall be forwarded to both Air Force Engineering Support Division, Gentile AFS, Dayton, OH 45444-5000 and Defense Electronics Supply Center, ATTN: DESC-EMM, Dayton, OH 45444-5281.

NONSTANDARD DELAY LINE,
PASSIVE, DRAWING EVALUATION CHECKLIST

Log no. _____	Adequate	Inadequate (see notes)	Missing
Drawing no. _____			
Drawing no. CAGE _____			
Vendor part no. _____			
Vendor part no. CAGE _____			
Delay lines acquired to this drawing meet all the requirements of MIL-D-83531 and as specified herein. In case of conflict, this drawing takes precedence.			
Vendor part number on drawing			
Vendor CAGE on drawing			
Dimensions			
Tolerances on dimensions			
Part marking (index mark minimum)			
Operating temperature range (minimum and maximum)			
Terminals (type designation in accordance with MIL-STD-1276)			
Schematic (circuit diagram)			
Weight			
Impedance (ohms)			
Delay time total			
Delay time taps			
Rise time			
Attenuation			
DC resistance			
Delay time variation with temperature			
Distortion			
Quality assurance provisions			
To be in accordance with DOD-STD-100 this drawing is correctly designated			

FIGURE 3. Drawing evaluation checklist.

NONSTANDARD DELAY LINE,
PASSIVE, DRAWING EVALUATION CHECKLIST

Log no. _____	Adequate	Inadequate (see notes)	Missing
Drawing no. _____			
Drawing no. CAGE _____			
Vendor part no. _____			
Vendor part no. CAGE _____			
Should be designated as: Specification control drawing Source control drawing Selected item drawing Altered item drawing			

FIGURE 3. Drawing evaluation checklist - Continued.

Custodians:

Army - ER
Navy - EC
Air Force - 85

Review activities:

Air Force - 11, 19, 99
DLA - ES

User activities:

Navy - AS, CG, MC, SH

Preparing activity:
Air Force - 85

Agent:
DLA - ES

(Project 5999-0170)